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Indian Standard

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(दूसरा पुनरीक्षण)

Gas Testing Flame Safety Lamps — Specification

(Second Revision)

ICS 73.100

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Mining Techniques and Equipment Sectional Committee had been approved by the Mechanical Engineering Divisional Council.

This standard was first published in 1975 and revised in 1986. This standard is being revised again to incorporate the amendments issued and the suggestions received from time to time. In this revised standard the sample size for routine tests have been modified.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GAS TESTING FLAME SAFETY LAMPS — SPECIFICATION

(Second Revision)

1 SCOPE

This standard covers the requirements for flame safety lamps used for the detection of combustible gases mainly composed of methane, in a mine or similar places.

2 CONSTRUCTION AND PERFORMANCE

2.1 General

Component parts of the lamp shall be manufactured from materials of adequate strength and of minimum weight; and careful attention shall be paid in the construction and assembly of the lamp. The external parts shall not be made of aluminium, magnesium, and their alloys.

2.1.1 The lamp shall be of robust construction so that under normal usage in mines. The lamp may not suffer any damage.

2.1.2 The manufacturing material shall be such that it shall not lose its safety quality when a proper attention of cleaning is given.

2.1.3 The lamp shall be of simple construction and shall be as simple as possible for servicing and maintenance. It shall not allow any flash to penetrate through joints, should some combustible gas happen to explode within the assembled lamp.

2.2 Oil Container

The oil container and the cap of the container shall be made of suitable material so as to be capable of resisting impact received in normal usage and not liable to any leakage. The filler cap shall be provided with a suitable washer so as to prevent oil leakage during normal working conditions.

2.2.1 If the filler cap in fuel vessel is not enclosed inside the outer glass, an arrangement shall be made to lock the filler cap to prevent unauthorized access to the fuel.

2.3 Lock

The lock shall be of magnetic or of any other effective type and shall be of a construction which shall not slacken or unlock during usage. The lead rivet locks shall not be used.

2.4 Gauzes

2.4.1 The safety lamp shall be fitted with a pair of gauzes, made of wires of steel, best charcoal annealed iron or other suitable material, meeting with any one set of the following requirements:

a) Both gauzes of nominal wire diameter 0.38 mm and of aperture of 530 microns;

b) Both gauzes of nominal wire diameter 0.42 mm and of aperture of 850 microns;

c) Both gauzes of nominal wire diameter 0.46 mm and of aperture of 810 microns; and

d) One gauze as indicated in (a) and the other gauze as indicated in either (b) or (c) .

2.4.1.1 *Tolerances*

a) Tolerance on aperture is 5 percent; and

b) Tolerance on wire diameter is + 0.01 mm.

2.4.2 The outer gauze shall have a heat radiating area of not less than 115 cm^2 and the inner gauze not less than 90 cm^2. The distance between inner and outer gauzes shall not be less the 1.5 mm and shall be of such construction that ordinary draught encountered in mines will not put out the flame or the gauzes shall not become over-heated to cause inflammable gas outside the tester to be ignited.

2.4.2.1 The lower edge of the inner gauze shall be reinforced with a non-detachable metallic collar so as to enclose it and also to provide a flat seating for the whole thickness of the upper end of the glass.

2.4.2.2 The lower edge of the outer gauze shall also be reinforced with a non-detachable metallic collar but in such a way as to accommodate properly and completely the metallic collar of the inner gauze, the gasket (washer ring) and a part of the top outer surface of the glass.

2.5 Gasket (Washer Ring)

2.5.1 The gasket shall be made of non-flammable material and shall not be less than 1.3 mm thick and 5 mm wide.

2.5.2 The external diameter of the gasket shall preferably be such as to permit tight fitting of the gasket

at the gauze end and at the glass-retaining ring and above and below the glass cylinder so as to minimize, while dismantling the glass cylinder, chances of fall out of the gaskets and subsequent deterioration in handling them.

2.5.3 The gaskets when assembled in the lamp shall provide for flame-tight joints at the upper and lower ends of the glass cylinder and it shall not be possible to loosen the glass by screwing it round with the fingers.

2.6 Bonnet

The design of bonnet shall be such as to protect the gauzes and to ensure the mine ventilation current does not impinge directly on the gauzes. The top of the outer gauze shall not be less than 5 mm below the bottom edge of the outlet port.

2.7 Glass Cylinder

The glass cylinder shall be of hard glass, uniform in composition and thickness, optically clear, without colour tints and shall be free from bubbles, flaws, cloudiness, etc. The thickness shall be 4.5 to 5.5 mm. The diameter and height of the glass cylinder shall be such as to ensure safety in the lamp when assembled. The planes of top and bottom faces shall, as far as possible, be flat and parallel and be at right angles to the axis of the cylinder. If after grinding, a bevel is applied, it shall not have the effect of reducing the useful seat width below a minimum value of 3 mm.

2.8 A suitable protector shall be provided to safeguard the glass cylinder. A straight edge placed across the outside of consecutive pillars shall not touch the glass.

2.9 The fuel used shall be of a suitable quality, for example, solvent fuel of motor spirit.

2.10 Relighting Mechanism

Relighting mechanism may be provided if agreed to between the user and the supplier. In case safety lamps are provided with relighting mechanism, the lighter shall be of construction which can be safely operated from outside and shall function effectively. A hot wire lighter operated by sealed rechargeable type miniature batteries or by any other suitable relighting mechanism is recommended.

2.11 The lighting duration of the lamp shall not be less than 10 hours with flame maintained to a height of 13 mm.

2.12 Wick

A circular wick shall be used for gas testing purposes.

2.13 Flame Adjusting Arrangement

A suitable arrangement shall be provided to adjust the flame to testing-flame position. It shall be so constructed that the explosion of the methane gas inside the lamp is not propagated outside the lamp.

3 TEST

3.1 Performance Test

The lighted lamp with wick adjusted to testing-flame position shall be placed in a closed vessel filled with fresh air and sufficient quantity of methane introduced into the vessel for making a mixture of concentration as per col 1 of Table 1. The length and conditions of blue flame produced shall be according to col 2 or 3 and 4, respectively of Table 1.

3.2 Wind Test

3.2.1 When sufficient air is blown from outside on the joint between wire gauze and glass cylinder and cylinder support (provided with packing), there shall be no flickering of flame provided that both inlet and outlet of the lamp itself are adequately protected from the draught.

3.2.2 The lamp shall be capable of burning normally and without extinction or undue flickering in currents of air with velocities of not less than 15 m/s.

3.3 Safety Tests

3.3.1 *Still Gas Test*

Place the unlighted lamp in an enclosure and pass methane into the enclosure until the methane content is 8 to 10 percent. Cause an explosion inside the lamp by means of the self-contained relighter. Repeat the test at least ten times. The ignition of methane and air mixture external to the lamp shall not result in any case.

3.3.1.1 Replace the fuel vessel by an ebonite or wooden base fitted with a spark gap and a tube for connection to an aspirating bulb. Place the assembly in an enclosure and pass methane into the enclosure until the methane content is 8 to 10 percent. Cause an explosion of the gas mixture drawn into the lamp by sparks across the spark gap induced from outside. Repeat the test at least ten times. The ignition of methane and air mixture external to the lamp shall not result in any case.

3.3.2 *Flow Gas Test*

With the lighted lamp placed in an enclosure, the concentration of methane in the methane and air mixture delivered into the enclosure at a suitable velocity is gradually increased (to about 5 percent), the gas continues to burn within the wire gauze. It is maintained for a minimum period of 20 min and then the concentration of methane is increased to 8 to 10 percent. The test shall be repeated at least ten times. The ignition of the gas mixture in the enclosure shall not result in any case.

Table 1 Performance Test Requirement for the Flame Safety Lamp

(*Clause* 3.1)

Concentration of Gas Percent	Approximate Height of Blue Flame with		Condition of Blue Flame
	Solvent Fuel mm	Motor Spirit mm	
(1)	(2)	(3)	(4)
0.0	—	—	A slight cobalt-blue lined orange-yellow flame seen near the top of standard flame (flame length of about 2.5 mm above upper edge of mouth piece). A faint light is seen along cobalt-blue line
1.0	7	6	Scarcely any formation of blue flame is seen as the flame colour is light and hence it is difficult to measure the length
1.5	9	8	Blue flame becomes a little more distinct, especially the lower part turns somewhat clear
2.0	12	11	Standard flame grows larger and blue flame becomes distinguishable but the top is invisible
2.5	14	14	Colour of blue flame becomes clearer but the top is still not distinct
3.0	18	18	Top of flame becomes barely visible and blue flame seen clearer
3.5	21	21	Blue flame clearly visible
4.0	25	25	Blue flame becomes extremely clear and highly sensitive to a slight change of gas content

NOTE — The length and conditions of blue flame given above, shall be those prevailing under normal conditions of atmospheric pressure, temperature and humidity without marked lack of oxygen and carbonic acid gas contents.

3.3.2.1 *Testing gallery*

The prototype gallery is essentially a rectangular steel duct with observation windows and explosion release. The outlet of the duct is connected to the inlet of the fan by means of a sheet metal tube, thus making it a close circuit system. Methane from a cylinder is fed into the gallery through a flow meter, provision being made for the introduction of additional methane and air flow to compensate for loss due to combustion within the lamp. The lamp is subjected to inclined current, either by tilting the lamp or introducing reflector plates across half the cross section of the gallery, so as to force the explosive mixtures towards or through any desired part of the lamp. At the bottom of the duct, a provision is made to take the sample of the mixture present within the duct.

The impeller fan is run by motor which controls the speed of the fan reproducing the speed of the methane and air mixture in the range of 150 m/min to 900 m/min within the duct.

The illustration of gallery is shown in Fig. 1.

3.3.2.2 *Method of test*

With the lighted lamp placed in the gallery, the concentration of methane and air mixture delivered to gallery at a suitable velocity is gradually increased (to about 5 percent), the gas continues to burn within the wire gauge (if such burning at all occurs) and it is maintained for a minimum period for 20 min. Then the concentration of methane is raised to most explosive mixture 8-10 percent while the speed of such explosive mixture of methane in air is varied in the gradual steps of 150 m/min, 300 m/min, 366 m/min and lastly 900 m/min, keeping the lamp exposed to such mixture at each step of speed for not less than 2 min. There shall not be any ignition/ explosion of the gas mixture in the gallery.

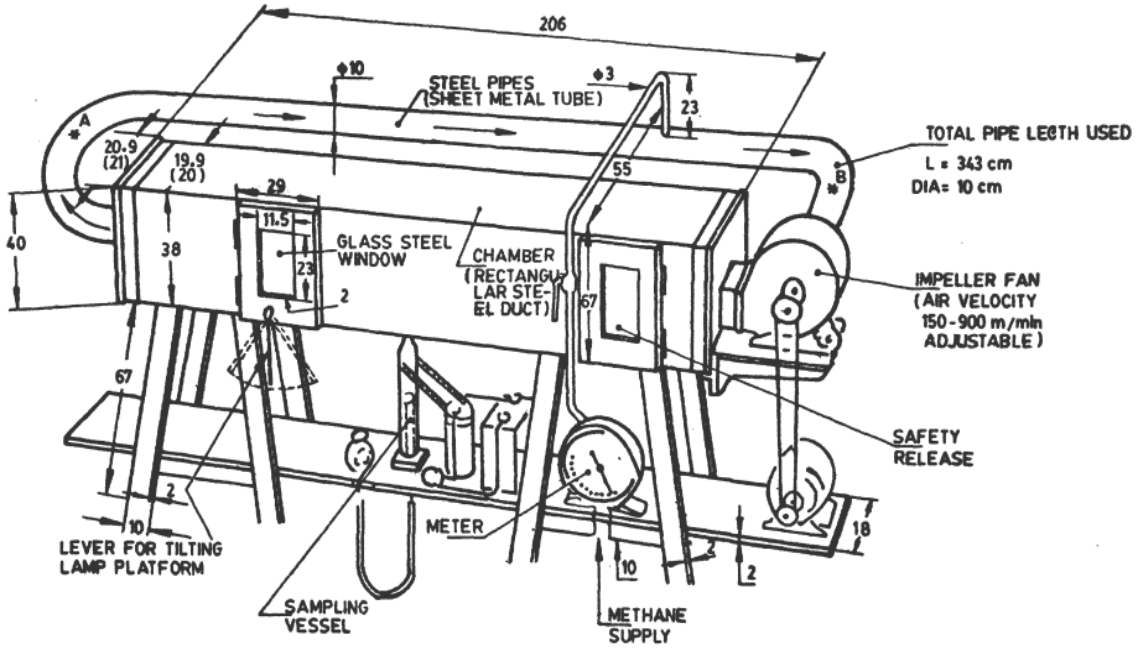
3.4 Strength Tests

3.4.1 *Lamp Assembly*

In the following three tests carried out on a lamp, fracturing of the glass cylinder or detachment of or damage to any component endangering safety shall be regarded as failure to pass the test.

3.4.1.1 The lamp in normal position shall be dropped five times from a height of 1 m on to a hard wooden board 30 mm thick laid on concrete floor. The dropping height shall be measured from the bottom of the lamp.

3.4.1.2 A load of 25 N in the form of a lead block of 75 mm diameter shall be dropped two times from a height of 2 m on the test lamp placed on a hard wooden board 30 mm thick laid on concrete floor, the glass cylinder having been changed in the second test. The dropping height shall be measured from the bottom of the load to the top of the lamp.



Distance *A to *B = 257 cm
All dimensions in millimetres

FIG. 1 GALLERY FOR TESTING LAMPS IN CURRENTS OF EXPLOSIVE MIXTURES

3.4.1.3 Attach one end of a steel wire 2 m long to the lower end of the lamp and the other end to a load of lead block of 120 mm diameter and 37 mm thick. The lamp shall be rigidly held at a height of 2.5 m from the floor and the load let fall three times from the bottom of the lamp.

3.4.2 *Gasket*

The gaskets shall have sufficient strength to withstand without perceivable damage a minimum of 50 trials of dismantling and assembly of glass cylinder in the lamp. Further, at the end of 50 trials, the decrease in the thickness of the gasket shall not be more than 0.3 mm.

3.5 Glass Cylinder Tests

3.5.1 *Type Tests*

At least 20 glass cylinders shall be subjected to each of the tests laid down in **3.5.3** and **3.5.4**. Cracking of fracturing of two or more glass cylinders shall constitute failure to pass the test.

3.5.2 *Routine Tests*

All glass cylinders manufactured shall be examined visually for any defects. Glass cylinders as specified in col 2 of Table 2 shall be subjected to tests laid down in **3.5.3** and **3.5.4**. Cracking or fracturing of any glass cylinder shall constitute failure of the lot to pass the test.

Table 2 Sampling

(*Clause* 3.5.2)

Sl. No	Lot Size	Sample Size
(1)	(2)	(3)
i)	Up to 100	4
ii)	101 to 150	6
iii)	151 to 200	8
iv)	201 to 300	10
v)	301 to 500	14

3.5.3 *Strength Test*

A load of 4.5 N in the form of a load disc of 63 mm diameter shall be dropped from a height of 1.2 m on the glass cylinder placed upright on a hard wooden board 30 mm thick laid on concrete floor. The dropping height shall be measured from the bottom of the load to the top of the glass cylinder.

3.5.4 *Temperature Test*

Glass cylinders, excluding the samples subjected to strength test shall be heated for one hour in an air-oven maintained at a temperature of 100°C and then plunged into cold water at 15°C. During heating, fifty percent of glass cylinders shall be placed upright and the remaining in horizontal position.

3.6 The surface temperature of the fuel vessel and the middle portion of the bonnet shall not exceed

57°C and 63°C respectively when the lamp has burnt continuously in an ambient temperature of 30°C with the flame maintained to a height of 13 mm.

4 PACKING

The flame safety lamps shall be properly packed in accordance with the best prevalent trade practices.

5 MARKING

The flame safety lamp shall be marked with the manufacturer's name or his recognized trade-mark and serial number. The glass cylinder shall be marked with the manufacturer's name or his recognized trade-mark. The glass cylinder shall also be marked with serial number or batch/lot number, if required by the purchaser. A copy of instructions book and other necessary documents shall also be supplied.

5.1 Standard Mark

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

5.1.1 Glass cylinders may also be marked with the Standard Mark.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Mining Techniques And Equipment Sectional Committee, MED 08

Organization	*Representative(s)*
Directorate General of Mines Safety, Dhanbad	Shri Prabhat Kumar (***Chairman***) Shri M. Arumugam (*Alternate*)
Andhra Pradesh Heavy Machinery and Engineering Ltd, Vijaywada	Shri T.V. Ramana
Bharat Coking Coal Ltd, Dhanbad	Shri P. K. Sinha
Bharat Earth Movers Ltd, Bengaluru	Shri V. R. S. Prasad Rao Shri H. G. Suresh (*Alternate*)
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Central Mine Planning and Design Institute Ltd, Ranchi	Shri S. K. Chaterji Shri U. Roy (*Alternate*)
Central Institute of Mining and Fuel Resesarch, Dhanbad	Dr M. K. Singh Shri Surajit Dey (*Alternate* I) Shri S. K. Kashyap (*Alternate* II)
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EIMCO Elecon (India) Ltd, Vallabh Vidyanagar	Shri B. K. Bhatt
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Directorate General of BIS, New Delhi	Shri Rajneesh Khosla, Scientist 'E' and Head, (MED) [Representing Director General (*Ex-officio*)]

Member Secretary

Shri Sandeep Keshav,
Scientist 'C' (MED), BIS

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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